Streaking comet fragments illuminate X-ray mystery

By Anne M. Stark
Newsline staff writer

Astrophysicists are narrowing the search for what produces X-ray emission by viewing a comet that is breaking up into at least three dozen fragments as it approaches Earth. Is it the comet itself, the solar wind hitting the comet, or a combination of the two?

Livermore physicists are part of an international collaboration of scientists on their way to figuring it out. By using NASA's Swift satellite and the Japanese Suzaku X-ray Observatory, Greg Brown and Peter Beiersdorfer of V Division, in collaboration with Scott Porter of NASA/Goddard Space Flight Center, Richard Willingale of the University of Leicester, Dennis Bodewits of KVI Atomic Physics, and Konrad Dennerl of the Max Plank Institute, are getting closer to pinpointing what exactly is causing the X-ray emissions from the comet named 73P/Schwassmann-Wachmann 3.

Comets are among the brightest sources of X-rays in the solar system. Scientists think that X-rays are produced through a process called charge exchange, in which highly charged particles from the sun that lack electrons steal electrons from chemicals in the comet. Typical comet material includes water, methane and carbon dioxide.

> *"If we can solve the comet mystery, we can solve Jupiter."*
>
> *– Peter Beiersdorfer*

"The Swift observations are amazing," said Brown, who led the proposal for Swift observation time through a Laboratory Directed Research and Development Exploratory Research project. "Because we are viewing the comet in X-rays, we can see many unique features."

Swift was put in space to locate gamma ray bursts which occur about once every two days. The opportunity to observe X-rays from 73P/Schwassmann-Wachmann 3 was too good to pass up. The comet began breaking apart in 1995 as a result of thermal stress caused by heating from the sun.

"We were lucky to be able to observe a comet while it's breaking apart," Beiersdorfer said. "The radiation is an indicator of what the solar wind and the comet are made of."

Three years ago, Beiersdorfer's team produced X-ray emissions in a laboratory setting by recreating the conditions that exist when solar wind collides with gases surrounding the nuclei of comets.

The team used the Electron Beam Ion Trap (EBIT) facility at the Laboratory to create charge exchange between heavy ions and neutral gas to produce the X-ray emissions, similar to what happens when the solar wind and gases collide in a comet.

The recent research is using that experimental work to understand what they are actually seeing in 73P/Schwassmann-Wachmann 3.

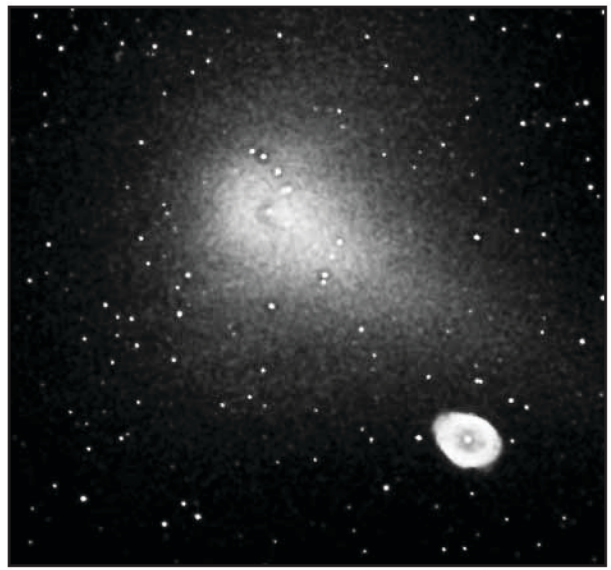

IMAGE COURTESY OF PETER BROWN/NASA/SWIFT/UVOT/PSU/

NASA's Swift satellite captured this image of comet 73P/Schwassmann-Wachmann 3 as it flew in front of the Ring Nebula.

"We're applying the laboratory simulations to analyze the X-rays from the comet," Brown said. He said measuring the charge exchange between the solar wind and the comet could help pinpoint what the comet is made of.

Beiersdorfer said once they figure out where the X-rays come from, the team could then solve why Jupiter emits X-rays.

"If we can solve the comet mystery, we can solve Jupiter," he said.